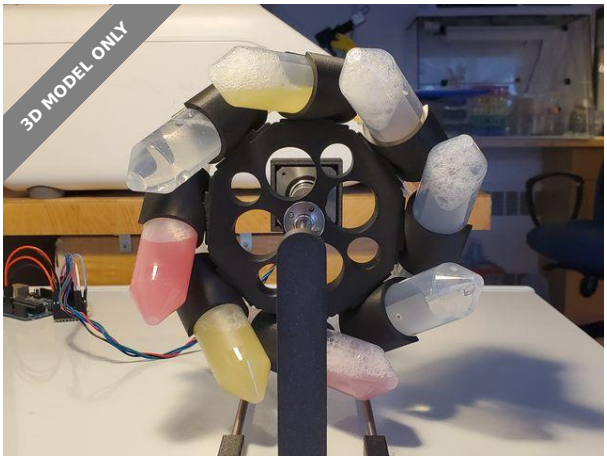

Sir Tumbalot v2 - Magnetic Deluxe

S **Scocioba**

VIEW IN BROWSER

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Summary

A modular magnetic tube tumbler for biological samples.

Learning > Chemistry & Biology

Tags: tumbler tube biology rotor moleculardbiology bacteria microbiology culture

Using a pancake stepper motor, 5mm rod, and a 5mm bearing, and some 12x6x3 magnets, this system allows for the rotation of a sample at a 45 degree tilt about two axes such that the internal liquid of the sample sloshes around as if rocking back and forth. The advantage here is that the direction of rotation remains constant thus less wear and tear on the system. As a result, a simpler instance of such a device has been continually rotating on our lab for the last two years non-stop.

To modify the design files, please see our TinkerCAD object file where you can edit these designs right in your browser for free:

https://www.tinkercad.com/things/aztrXrMCsm2

Parts List:

Pancake Stepper Motor:

https://a.co/d/cKmp9Y5

Magnets 12x6x3mm (need 16 of these):
https://www.amazon.com/gp/product/B09L47HV7M/ref=ppx_yo_dt_b_search_asin_title?ie=UTF8&psc=1

5mm Rods (you need 3): https://www.amazon.com/gp/product/B00UCR6VOK/ref=ppx_yo_dt_b_search_asin_title?ie=UTF8&psc=1
5mm Bearing:
https://www.amazon.com/gp/product/B071RXC7FV/ref=ppx_yo_dt_b_search_asin_title?ie=UTF8&psc=1

5mm Shaft Coupler:
https://www.amazon.com/dp/B0BP87Q4PC/ref=cm_sw_r_apanp_jQ36YUpTExQSn

Flange Coupling Connector:
https://www.amazon.com/gp/product/B08334MFVT/ref=ppx_yo_dt_b_search_asin_title?ie=UTF8&psc=1

Trinamic 2209 Stealth Chop Dev Board:
https://www.mouser.com/ProductDetail/Trinamic/TMC2209-BOB?qs=TiOZkKH1s2Qe%2F0oCs8WMDg%3D%3D

Crimp on pin headers (DuPont Connector)

https://a.co/d/7HGjm6S

Female Pin header Kit

https://a.co/d/0HIC8a4

Rubber feet

https://a.co/d/ahQm9Wy

Misc:

Arduino UNO from various suppliers.

9v power wall-wart from various suppliers for arduino uno boards.

M3 x 30mm screws

22 guage stranded core wire

Metric allen wrench set

Needle-nose pliers

Instructions:

1. Download and install the TMCStepper Arduino library, linked here: https://github.com/teemuatlut/TMCStepper
2. Print all the included parts and/or modify the parts in TinkerCAD as linked above.
3. Print 8 matching tube adaptors or design your own to fit that magnetic slot dimension.
4. Install 12x6x3mm magnets in the rotor, keeping identical polarities facing upward across all 8 magnet slots. Use black silicone sealant to adhere the magnets if friction fit is not enough.
5. Install similar magnets to each of the tube adaptors, check the polarity such that each tube adaptor is attracted to the rotor slot magnets. Only test magnetic pull once rotor magnet sealant is cured to avoid ripping magnets out of their slots. Ensure the tube adaptor magnets are flush with the flat rectangular surface. Connect all tube adaptors to the rotor to check polarities and ensure all tube adaptors mate in the same direction.
6. Strip 4mm off each of the wires attached to the stepper motor.
7. Crimp on male DuPont connector to each wire and slide on black plastic DuPont connector sheath.
8. Solder female pin header rows to the Stealth Chop Dev Board.
9. Slide the stepper motor wires through the printed stepper housing.
10. Connect the stepper wires to the Dev Board as follows: A1: Black, A2: Green, B1: Red, B2: Blue
11. Connect the Vio pin to Arduino 3v
12. Connect the Vmot pin to Arduino 5v
13. Connect the DIR, STEP and ENABLE pins on the Stealth Chop Dev Board to Arduino pins 4, 5, and 6 respectively.
14. Connect GNDmot and GNDio grounds to Arduino GND pins.
15. Connect the motor shaft to the 5mm rod via the shaft coupler. Ensure the shafts meet in the middle of the coupler and tighten.
16. Slot the 5mm bearing into the printed bearing housing.
17. Slot the bottom 5mm rods to the housing feet and push everything together, aligning the 5mm motor rod into the 5mm bearing bore.
18. Upload the included code to the Arduino, the motor should begin rotating. If it makes a stall noise just give the motor rod a manual twist in the direction of rotation to overcome initial friction. Take note of any wobble or eccentricities. If there is wobble, cut power to the Arduino and adjust the shaft coupling since that is the central source of wobble. There will always be a bit of wobble due to shaft manufacturing defects.
19. Attach the two flange couplers to the rotor and fasten with M3x30mm screws. Be mindful of the tiny worm screws in the flange as they may get lost.

20. Disassemble the bearing housing from the 5mm rods and slide the rotor onto the 5mm motor shaft, center it, reattach the bearing housing to all the rods. Once rotor is centered, screw in the worm screws to secure the rotor to the motor shaft.
21. Ensure everything is pushed together firmly. Apply rubber feet to the bottom of each printed housing. Turn on the Arduino and see if it spins. Remember if it stalls just give it a twist to help it start.

Model files

sir-tumbalot-v2-magnetic-deluxe-1.stl

Motor Housing

sir-tumbalot-v2-magnetic-deluxe.stl

Rotor

sir-tumbalot-v2-magnetic-deluxe-2.stl

Bearing Housing

sir-tumbalot-v2-magnetic-deluxe-3.stl

50mL Tube Holder

Other files

sirtumbalot-v2.ino

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